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Examining the secondary school mathematics practices course books in Turkey according to the principles of the model eliciting activity design[1]

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Abstract

In the study, it was aimed to examine the activities in the Secondary School Mathematics Practices course books taught within the scope of mathematics practices course in Turkey and published by the Ministry of National Education, according to the principles of Model Eliciting Activity (MEA) design. For this purpose, document analysis technique, one of the qualitative research methods, was used. The data source of the study consisted of Secondary School Mathematics Practices course books (6th, 7th and 8th grades) taught since 2017. During the data analysis phase of the study, six MEA design principles (reality, model eliciting, self-assessment, structure documentation, model generalization and effective prototype principle) proposed by Lesh et al. (2000) were taken into account. According to the results obtained from the study, the principle of self-evaluation was the principle of designing the MEA that provided the lowest level of activities in the 6th and 7th grade Mathematics Practices course book. The activities in the 8th grade course book, on the other hand, scored slightly above the intermediate level in terms of the principle of self-evaluation. It was determined that the activities in the books for all three levels were more than moderately suitable for the model generalization principle, and that they were prepared in accordance with the principles of effective prototype and reality. When the activities in the course books were examined in terms of the model documentation principles, it was determined that the activities in the 7th grade course book were below the medium level, while the activities in the 6th and 8th grade course books were found to be above the medium level. As a result, it was concluded that the activities in the Mathematics Practices course books of all three grade levels generally provided the MEA design principles above the intermediate level.

Keywords: Mathematical modeling; model eliciting design; mathematics practices; course book.

1. Introduction

One of the most important objectives of the mathematics course is to raise individuals who can apply mathematics in daily life and who can easily solve real life problems. In line with this purpose, the general objectives of the compulsory mathematics course in

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Turkey were supported and the Mathematics Practices course was put into practice as an elective course in the 2012-2013 academic year in order for students to have more advanced problem-solving experiences (Ministry of National Education [MONE], 2013). With the inclusion of the Mathematics Practices course in the teaching process, it is expected that the students will develop a positive attitude towards mathematics, as well as enable them to see the real-life application areas of the subjects in mathematics lessons. With this expectation, it is aimed that students develop their mathematical thinking skills by preventing them from rote operations in mathematics lessons. When the secondary school Mathematics Practices course curriculum is examined (MONE, 2018), it is noted that the mathematical modeling approach is taken as a basis in the implementation of the course. In addition, this course aims to develop students' problem solving-posing, reasoning, communication, associating skills between mathematical concepts, between mathematics and other disciplines, between mathematics and daily life.

It is clear that mathematical modeling activities involving real-life problem situations will contribute to the realization of these goals. One of the most effective tools that bring mathematical modeling activities to the learning environment is the course books prepared according to the program. Course books are a bridge for presenting the curriculum in the curriculum to students (Thompson, 2014) and guide teachers in presenting information in the classroom environment. In this context, Course Books enriched with modeling practices appear as an important factor in the transfer of mathematical modeling to the learning environment. Modeling activities to be designed should have some features that have been agreed in the literature. Researchers (Blum & Borromeo-Ferri, 2009; Czocher, 2017) state that a modeling activity should reveal the modeling process and enable it to be observed easily. Therefore, modeling design principles appear as an important guide in the development of mathematical modeling activities (Doerr & English, 2003). Researchers stated that there should be six basic principles in mathematical modeling activities: reality, model eliciting, self-evaluation, model documentation, model generalization and effective prototype (simplicity) (Lesh, Hoover, Hole, Kelly & Post, 2000). To briefly explain these design principles; according to the reality principle, activities should be designed based on real or lifelike data. According to the principle of model eliciting, the aim while designing an activity should be to develop a structure that can be evaluated, explained and predicted that leads to a result, rather than achieving a result. So, the event has a graph, equality, etc. It should be in a way that will allow model development. According to the principle of self-evaluation, in the activity, students should be able to evaluate the appropriateness and usefulness of their own solution approaches without seeking the opinions of their teachers. The principle of model documentation involves revealing students' own thoughts and solutions and documenting them in a way that a client/client can understand. With the model generalization principle, students are asked to create models

that can be used by others for similar situations or that can be used in similar situations, and students are asked to produce more general information beyond their personal information. Finally, according to the principle of effective prototype (simplicity), the models developed by students should be as simple as possible but also mathematically meaningful. In addition, even if it takes a long time to solve the problem, students should be able to remember the solution when they encounter similar situations in terms of structure. In order for mathematical modeling activities to be suitable for their purpose, design principles should be considered and the existence of these principles should be tested in the activities developed (Doerr & English, 2003; Lesh & Doerr, 2003).

In line with the emphasis on mathematical modeling in the mathematics curriculum, it is an important issue to reveal the extent to which the mathematical modeling activities in the Course Books reflect the modeling process. When the studies on mathematical modeling are examined, it is seen that the studies investigating the mathematical modeling activities in the Course Books are quite limited. In the study conducted by Çavuş-Erdem, Doğan, Gürbüz, and Şahin (2017), how much mathematical modeling is included in all secondary school (5, 6, 7, 8) mathematics Course Books in the 2016-2017 academic year and how the concept of modeling affects mathematical modeling. extent has been studied. According to the results of this research, it was stated that the concept of modeling in the Course Books examined only meant concretization and visualization. Based on this result, the researchers stated that the modeling approach in the Course Books should be revised considering the emphasis on mathematical modeling in the mathematics teaching program. Doruk (2019), on the other hand, examined the level of compatibility of problem solving activities in the 5th grade Mathematics Practices course teaching material with model eliciting activity (MEA) design principles. As a result of the study, it was stated that the level of providing the MEA design principles of the activities included in the teaching material was above the medium level. When the other studies on the Mathematics Practices course are examined, it is observed that the difficulties encountered in the implementation of the course in general (Boyraz & Güçlü, 2018; Çoban & Erdoğan; 2013) and the views about the course (Çelikel & Yelken, 2017; Erdem & Genç, 2014; Keşan, Coşar & Erkuş, 2016) seems to be focused.

It is an important issue to investigate whether the Mathematics Practices course books include modeling activities at a level that will improve the ability to relate mathematics and real life, and to what extent this course is qualified in gaining the modeling approach on which the curriculum is based. When the related studies are examined, it is seen that only the 5th grade Course Books among the Mathematics Practices Course Books are investigated for their compatibility with model eliciting design principles (Doruk, 2019). In this study, the 6th, 7th and 8th grade Mathematics Practices Course Books that have been taught since 2017 were examined according to the MEA design principles. Thus, it is aimed to contribute to the elimination of this gap in the field by revealing how much the activities in the secondary school Mathematics Practices Course Books reflect the

mathematical modeling approach. However, it is thought that the results of the study will guide curriculum developers and book authors in organizing activities related to mathematical modeling in the content of the courses and Course Books. In this context, in this study, it is aimed to examine the activities in the secondary school Mathematics Practices Course Books (6th, 7th and 8th grades) taught in Turkey since 2017 and published by the MEB publishing house, according to the MEA design principles. For this purpose, answers to the following sub-problems were sought:

- To what extent do the activities in the 6th grade Mathematics Practices Course Book comply with the principles of MEA activity design?
- To what extent do the activities in the 7th grade Mathematics Practices Course Book comply with the principles of MEA activity design?
- To what extent do the activities in the 8th grade Mathematics Practices Course Book comply with the principles of MEA activity design?

2. Method

In this part of the study, information about the research design, data collection tool and data analysis is given.

2.1. Research design

In this study, document analysis technique, one of the qualitative research methods, was used. Document analysis is a qualitative research method used to analyze the content of written texts in a detailed and systematic way (Wach, 2013; Yıldırım & Şimşek, 2008). This analysis technique is a systematic method used to scrutinize and evaluate all documents, including printed and electronic materials. The biggest advantage is that the researcher decides the sample size himself, but he can adjust the number of it as he wishes. In this context, the compliance of the activities in the 6th, 7th and 8th grade mathematics practice Course Books in Turkey with the MEA design principles was examined.

2.2. Data source

The data source of the study consists of Secondary School Mathematics Practices Course Books (6th, 7th and 8th grades) taught in Turkey since 2017.

2.3. Data analysis

During the data analysis phase of the study, six modeling design principles (reality, model eliciting, self-assessment, structure documentation, model generalization, and effective prototyping principle) proposed by Lesh et al. (2000) were taken into account. In

this study, in which content analysis was used, first of all, the form in Appendix-1, which was developed by Doruk (2019) and which lists the criteria that an activity must meet for each modeling principle, was used. Doruk (2019) developed criteria for the effective prototype principle, which was not taken into account in many studies (Tekin Dede & Bukova Güzel, 2013; Urhan & Dost, 2017) conducted in this form, which he developed to examine the level of compliance of the fifth grade Mathematics Practices course teaching material with the principles of model eliciting activity design. . As Doruk (2009) stated, experts can control whether the effective prototype principle is achieved, even in an activity that has not been implemented yet. For this reason, in this study, the availability of the "effective prototype" principle was also examined through the criteria specified in the relevant form. The form includes a total of 19 criteria, including 4 reality principles, 5 model eliciting principles, 3 self-assessment principles, 2 model documentation principles, 3 effective prototypes and 2 model generalization principles. By means of this form, the activities in each of the 6th, 7th and 8th grade Mathematics Practices Course Books were examined according to the relevant criteria, and the activity was scored 0 if it did not meet the relevant criteria, 1 if it partially met, and 2 if it fully met it. Then, making use of the evaluation system used by Doruk (2009), the total score of the activities from the criteria of each principle is divided into the highest total score that can be obtained from the criteria of the relevant principle. The level of providing the relevant principle of the activities was calculated to be between 0 and 1 point. In the evaluations made in this context, it has been taken into account that as the calculated value approaches 1, the level of ensuring the principle of efficiency increases and decreases as it approaches 0. Finally, the score of each activity for all criteria is divided by the total score that can be obtained from all criteria in the form, and the general suitability levels of the activities for the MEA design principles are obtained. After digitizing the qualitative data, it was analyzed with the help of descriptive statistical methods.

2.4. Validity and reliability

In the evaluation of the activities in the books, two researchers who worked in the field scored the activities separately. Afterwards, the scores were examined and it was determined that the scoring values of the two researchers were largely compatible. The criteria that differed in scoring were reviewed and a consensus was reached on scoring.

3. Findings

Findings of the study are presented and tabulated under separate headings as in the following:

3.1. Compliance of the Activities in the 6th Grade Mathematics Practices Course Book with MEA Design Principles

The findings obtained as a result of the examination carried out to determine the compliance levels of 32 problem solving activities in the 6th grade Mathematics Practices Course Book with MEA design principles are presented in Table 1.

Table 1. General Evaluation of Compliance Level of 6th Grade Mathematics Practices Course Book with MEA Design Principles

MEA Design Principles	Mean	Max.	Min.
Model Eliciting	0.46	1	0
Reality	0.64	1	0.13
Model Generalization	0.58	1	0
Effective Prototype (Simplicity)	0.82	1	0.17
Model Documentation	0.55	1	0
Self-assessment	0.44	0.83	0
Compliance with MEA design principles	0.54	0.92	0.32

When Table 1 is examined, it is seen that the general average is 0.54 as a result of the analysis made by using all six basic principles taken into account for the compliance of the activities in the 6th grade mathematics practices Course Book with the MEA design principles. From this point of view, it has been determined that the 6th grade mathematics practices Course Book provides MEA design principles above the intermediate level. However, when the activities were evaluated in terms of compliance with the principles of "model eliciting" and "self-assessment", it was determined that they scored below the medium level. The MEA design principle, which is provided at the highest level by the activities in the 6th grade mathematics practices Course Book, has been determined as the "effective prototype (simplicity)" principle. In addition, when the activities were evaluated in terms of "reality", "model generalization" and "model documentation" principles, it was determined that they scored above the medium level.

Table 2 below shows the level of compliance with the MEA design principles of 32 activities in the 6th grade mathematics practices course book and the level of providing the six principles that are effective in determining these levels. When the values given in Table 2 approach 1, it means that the level of providing the relevant principle and being in compliance with the MEA design principles increases, while the values approaching 0 decrease.

Table 2. Compliance Level of Activities in the 6th Grade Mathematics Practices Course Book with MEA Design Principles

Activity No	Model Eliciting	Reality	Model Generalization	Effective Prototype	Model Documentation	Self-assessment	Compliance with MEA
1	0.4	0.63	0.5	1	0.5	0.5	0.58
2	0.7	0.88	0.5	1	0.75	0.67	0.76
3	0.4	0.63	0	0.83	0.5	0.5	0.5
4	1	0.75	1	1	1	0.83	0.92
5	0.4	0.75	0	0.66	0.75	0.67	0.55
6	0.1	0.13	1	0.66	0.25	0.33	0.34
7	0	0.13	0.5	0.83	0.5	0.33	0.32
8	0.3	0.73	0.5	1	0.5	0.5	0.55
9	0.3	0.88	0.25	0.83	0.75	0.67	0.63
10	0.3	0.88	0.5	1	0.25	0.33	0.53
11	0.6	1	0.5	1	0.25	0.33	0.66
12	0.3	0.63	0.5	0.66	0.75	0.5	0.53
13	0.1	0.38	0.5	1	0	0.17	0.34
14	0.8	0.88	1	1	1	0.83	0.89
15	0.8	0.5	0.75	1	0.75	0.5	0.68
16	0.8	0.75	0.5	0.5	0	0.17	0.53
17	0.6	0.13	1	1	0	0.5	0.53
18	0.4	0.25	1	1	0.5	0.33	0.53
19	0.1	0.63	0.5	1	0.25	0.5	0.47
20	0.5	0.5	0.75	1	1	0.5	0.66
21	0.7	1	0.5	0.33	1	0.17	0.63
22	0.8	1	1	0.83	1	0.5	0.84
23	0.2	0.88	0.75	0.66	0.5	0.17	0.5
24	0.7	0.25	0.25	0.5	0.75	0.17	0.45
25	0.5	0.5	0.5	0.83	0.5	0	0.47
26	0	0.25	0.25	1	0	0.5	0.32
27	0.7	1	0.75	0.66	0.5	0.67	0.74
28	0.10	0.38	0.5	1	0	0.5	0.4
29	0.9	0.88	0.75	0.66	1	0.67	0.82
30	0.3	1	0.25	0.83	1	0.5	0.63
31	0	0.88	0.25	0.17	0.25	0.5	0.34
32	0.8	0.5	1	0.83	0.75	0.17	0.66
Mean	0.46	0.64	0.58	0.82	0.55	0.44	0.54

When Table 2 is examined, it is seen that nine out of 32 activities (6,7,13,19,24,25,26,28,31) comply with the MEA design principles below 0.5, which is considered moderate. The activity that provides the MEA design principles at the highest level is activity number 4, and the activities that provide the lowest level are activities 7

(see Appendix 2) and 26. However, when the activities in the book are compared according to the general average score of the MEA design principles obtained (0.54), half of the activities were below the general average obtained, while the other half scored above the general average.

In the 6th grade mathematics practices Course Book, the activity numbered seven, which provides the MEA design principles at the lowest level, is given in Appendix 2. When the activity is examined, students are asked to choose the appropriate numbers for the given operations. In this respect, this activity directs students to take action and find results rather than putting them in a situation that will make them realize the need for model development. For this reason, the level of meeting the modeling principle of this activity was evaluated as zero. When it is examined in terms of the reality principle, there is no scenario in the event that includes the real-life situation. The activity was evaluated only partially in accordance with the criterion "Students can make sense of the problem situation based on their own experience and knowledge". In the third question of the activity, the students were asked to explain how they chose the numbers so that the answer of a division operation would be the smallest number/largest number. In this respect, it has been determined that the principle of model generalization is taken into account, albeit partially. However, considering that the activity is far from complexity, the solution of the problem, albeit partially, provides a useful prototype for interpreting similar problem situations and does not involve complex computational procedures, it has been evaluated in accordance with the principle of effective prototype. Although it was not included in the first two questions of the activity, in the third question, the students were asked to explain the choice they made for the division operation, and the model was considered partially in accordance with the documentation principle. Similarly, although the efficacy does not include eligibility criteria to evaluate the usefulness of alternative solutions, it has been partially evaluated in accordance with the principle of self-evaluation in terms of being able to check the results or decide for himself whether it is necessary to correct.

3.2. Compliance of the Activities in the 7th Grade Mathematics Practices Course Book with MEA Design Principles

The findings obtained as a result of the examination carried out to determine the compliance levels of 41 problem solving activities in the 7th grade mathematics practices Course Book with MEA design principles are presented in Table 3.

Table 3. General Evaluation of the Compliance Level of the 7th Grade Mathematics Practices Course Book with the MEA Design Principles

MEA Design Principles	Mean	Max.	Min.
Model Eliciting	0.63	1	0.1
Reality	0.62	1	0.13
Model Generalization	0.56	1	0
Effective Prototype (Simplicity)	0,72	1	0.17
Model Documentation	0.46	1	0
Self-assessment	0,33	1	0
Compliance with MEA design principles	0,57	0,97	0.16

When Table 3 is examined, it is seen that the general average is 0.57 as a result of the analysis carried out to determine the compliance of the activities in the 7th grade mathematics practices Course Book with the MEA design principles. From this point of view, it has been determined that the 7th grade mathematics practices Course Book provides MEA design principles above the intermediate level. When the activities were evaluated in terms of compliance with the principles of "model documentation" and "self-assessment", they scored below the intermediate level. The MEA design principle, which is provided at the highest level by the activities in the 7th grade mathematics practices Course Book, was determined as the "effective prototype (simplicity)" principle, as in the 6th grade book. In addition, when the activities were evaluated in terms of "model eliciting", "reality" and "model generalization" principles, they scored above the medium level.

Table 4 shows the findings related to the level of compliance with the MEA design principles of 41 activities in the 7th grade mathematics practices Course Book and the level of ensuring the six principles that are effective in determining these levels.

Table 4. Compliance Level of Activities in the 7th Grade Mathematics Practices Course Book with MEA Design Principles

Activity No	Model Eliciting	Reality	Model Generalization	Effective Prototype	Model Documentation	Self-assessment	Compliance with MEA
1	0.5	0.88	0.5	0.67	0.5	0.5	0.61
2	0.8	1	1	1	0.75	0.67	0.87
3	0.5	0.38	0.5	0.17	0	0	0.32
4	0.7	0.75	0	0.67	0.5	0.5	0.58
5	1	1	1	0.83	1	1	0.97
6	0.9	0.63	0.5	0.83	1	1	0.82
7	0.4	0.5	0	0.67	1	1	0.58
8	1	1	1	0.83	1	1	0.97
9	0.8	0.88	0.5	0.83	0.75	0.5	0.74
10	0.7	0.88	1	1	0.75	0.34	0.76

11	0.7	0.88	0.5	0.34	0.25	0.34	0.55
12	0.7	0.75	1	1	0.5	0.34	0.71
13	0.2	0.13	0	0.34	0	0.17	0.16
14	0.6	0.63	0	0.34	0	0	0.4
15	0.5	0.75	0	0.83	0.25	0.17	0.47
16	0.7	0.88	0.5	0.83	0	0.17	0.58
17	0.4	0.38	0	0.5	0.5	0.17	0.34
18	0.9	0.38	1	0.83	0.5	0.5	0.68
19	0.5	0.38	0.75	1	0.25	0.17	0.5
20	1	0.63	1	1	0	0.34	0.71
21	1	0.63	1	0.67	0.5	0.5	0.74
22	1	0.75	1	0.67	0.5	0.17	0.71
23	0.9	0.25	1	0.67	0.5	0.34	0.61
24	0.3	0.38	0.75	1	0.75	0.17	0.5
25	0.8	0.88	0.5	1	0.75	0.5	0.76
26	0.3	0.38	0.25	0.83	0	0	0.34
27	0.6	0.75	0.75	1	0.25	0.17	0.61
28	0.7	0.63	0.25	0.67	0	0	0.45
29	0.4	0.63	1	1	1	0.17	0.63
30	0.8	0.5	1	0.67	0.5	0.34	0.63
31	0.8	0.38	0.25	0.5	0.25	0.17	0.45
32	0.4	0.25	0	0.83	0.5	0	0.34
33	0.8	0.88	1	0.67	1	0	0.71
34	0.4	0.25	1	1	0.75	0.5	0.58
35	0.9	0.38	1	0.67	0.25	0.17	0.58
36	0.1	0.88	0.25	0.83	0.25	0.17	0.42
37	0.2	0.25	0.25	0.5	0.5	0.17	0.29
38	0.2	1	0.5	0.5	0.25	0.5	0.5
39	0.6	0.75	0.5	0.5	0.25	0	0.47
40	0.1	0.25	0.25	0.5	0	0.17	0.21
41	1	0.75	0.25	0.5	0.75	0.34	0.66
Mean	0.63	0.62	0.56	0.72	0.46	0.33	0.57

When Table 4 is examined, it is seen that 13 out of 41 activities (3, 13, 14, 15, 17, 26, 28, 31, 32, 36, 37, 39, 40) comply with MEA design principles below 0.5, which is considered moderate. The activity that provides the MEA design principles at the highest level is activity 5 (see Appendix 2), and the activity that provides the lowest level is activity 37. However, when the activities in the book were compared according to the general average score of the MEA design principles obtained (0.57), 17 (41.5%) were below the general average obtained, while 24 (58.5%) scored above the general average.

Activity number 5, "Sesame Street", which provides the highest level of MEA design principles in the 7th grade mathematics practices course book, is given in Appendix 2.

When the activity is examined, it is seen that the problem situation is in a structure that can be encountered in real life and can be perceived realistically for students. In addition, the activity was prepared in accordance with the reality principle in order for the students to make sense of the problem situation based on their own experiences and knowledge. When examined in terms of model creation principle, it is seen that there are directives that require model creation in the activity. In terms of model generalization principle, it is desired to create new models for different situations. However, the activity includes instructions that will require students to explain the models they have created and their solutions. In this context, the model has been evaluated in accordance with the documentation principle. When examined in terms of the effective prototype principle, it is seen that the activity is far from complexity and does not require complex computational procedures. It was only considered partially compatible with the condition that the probable solution to the problem would provide a useful prototype for interpreting structurally similar problem situations. The last question of the activity includes instructions for students to evaluate the usefulness of alternative solutions. In this respect, the activity was designed in accordance with the principle of self-evaluation so that students can check the accuracy of their own interpretations and conclusions and decide whether there is a need for improvement or correction.

3.3. Compliance of the Activities in the 8th Grade Mathematics Practices Course book with MEA Design Principles

The findings obtained as a result of the examination carried out to determine the compliance levels of 40 problem solving activities in the 8th grade mathematics practices course book with the MEA design principles are presented in Table 5.

Table 5. General Evaluation of the Compliance Level of the 8th Grade Mathematics Practices Course Book with the MEA Design Principles

MEA Design Principles	Mean	Max.	Min.
Model Eliciting	0.52	1	0
Reality	0.65	1	0.25
Model Generalization	0.56	1	0
Effective Prototype (Simplicity)	0.73	1	0.17
Model Documentation	0.51	1	0
Self-assessment	0.51	1	0
Compliance with MEA design principles	0.59	0.97	0.24

When Table 5 is examined, it is seen that the general average is 0.59 as a result of the analysis carried out to determine the compliance of the activities in the 8th grade mathematics practices course book with the MEA design principles. From this point of view, it has been determined that the 8th grade mathematics practices course book

provides MEA design principles above the intermediate level, as in the 6th and 7th grade books. The MEA design principle, which is provided at the highest level by the activities in the 8th grade mathematics practices course book, was determined as the "effective prototype (simplicity)" principle, similar to the 6th and 7th grade books. The design principle with the highest score after the simplicity principle was determined as the "reality" principle. Model generalization, model eliciting, model documentation, and self-evaluation principles scored moderate.

Table 6 below shows the findings related to the level of compliance with the MEA design principles of 40 activities in the 8th grade mathematics practices course book and the level of providing the six principles that are effective in determining these levels.

Table 6. General Evaluation of the Compliance Level of the 8th Grade Mathematics Practices course book with the MEA Design Principles

Activity No	Model Eliciting	Reality	Model Generalization	Effective Prototype	Model Documentation	Self-assessment	Compliance with MEA
1	0	0.75	0	0.83	0.25	0.67	0.47
2	0.1	0.25	0.25	1	0.5	0.67	0.42
3	0.4	0.63	0.75	0.83	0.5	0.33	0.55
4	0.3	0.38	0.5	0.83	0.5	0.33	0.45
5	0.7	0.38	0.5	0.5	1	0.5	0.58
6	0	0.63	0.25	0.83	0	0.67	0.40
7	0	0.75	0.5	0.5	0	0.33	0.34
8	0.5	0.75	0.5	0.67	0.5	0.5	0.58
9	0.1	0.38	0.5	0.67	0	0.33	0.32
10	0.7	0.88	1	0.7	1	0.83	0.82
11	0.9	0.75	0.5	1	1	0.67	0.82
12	0.8	0.63	1	0.83	0.5	0.67	0.74
13	0.5	0.63	0	0.83	1	0.67	0.61
14	0.2	0.63	0.5	0.5	0.75	0.67	0.50
15	0.2	0.63	0.25	0.83	0.75	0.67	0.53
16	1	0.75	0.5	0.83	1	1	0.87
17	0.9	0.75	1	0.83	1	0.83	0.87
18	0.6	0.5	0.5	0.67	0.25	0.17	0.47
19	0.8	0.75	0.5	1	0.75	0.83	0.79
20	0.3	0.38	0	0.83	0.25	0.5	0.40
21	0.9	0.63	0	0.83	0.25	0.17	0.55
22	0.6	0.88	1	1	0.5	0.83	0.79
23	0.8	0.63	1	0.83	0.75	0.33	0.71
24	1	0.63	1	0.83	0.75	0.5	0.79
25	1	0.88	1	0.67	1	0.67	0.87
26	1	0.88	1	0.17	0.75	0.17	0.71
27	1	0.88	1	1	1	1	0.97

28	0.9	0.5	1	0.67	0.5	0.83	0.74
29	0.1	0.63	0.25	0.17	0	0.17	0.24
30	0	0.38	0.5	1	0	0.5	0.37
31	0	0.25	0.25	0.67	0	0.5	0.26
32	0.1	0.75	0.5	0.83	0.5	0.17	0.47
33	0.8	1	1	0.83	0.75	0.83	0.87
34	0.3	0.75	0	0.67	0.25	0.33	0.42
35	0.4	0.88	0	0.33	0.5	0	0.40
36	0.1	0.63	0	0.33	0	0.17	0.24
37	0,6	0.5	1	0.67	0	0.33	0.53
38	0.9	0.88	1	0.83	1	0.67	0.87
39	0.5	0.5	1	1	0.25	0.33	0.58
40	0.8	0.63	0.5	0.5	0.25	0.17	0.53
Mean	0.52	0.65	0.56	0.73	0.51	0.51	0.59

When Table 6 is examined, the compliance of 15 out of 40 activities (1, 2, 4, 6, 7, 9, 18, 20, 29, 30, 31, 32, 34, 35, 36) with the MEA design principles is less than 0.5, which is considered moderate. appears to be below. The activity that provides the MEA design principles at the highest level is activity 27, and the activity that provides the lowest level is activity 29. However, when the activities in the book were compared according to the general average score of the MEA design principles obtained (0.59), 24 (60%) were below the general average, while 16 (40%) scored above the general average.

4. Conclusion and Discussion

As a result of this research, in which the activities included in the secondary school 6th, 7th and 8th grade mathematics practices course books, which have been taught in Turkey since 2017 and published by the MEB publishing house, were examined according to the MEA design principles, the MEA design principles of the activities in the mathematics practices course books of all three grade levels were examined. It was concluded that it provided above the medium level. This result of the study is in parallel with Doruk's (2019) study in which he examined the problem solving activities in the 5th grade mathematics applications course teaching material in terms of compliance with the MEA design principles. However, apart from this general evaluation of the study, when the activities in the books are examined one by one, it is concluded that there are also activities that provide the MEA design principles at a very low level. Particularly, most of the activities (60%) in the 8th grade mathematics practices course book were below the general average in terms of compliance with the MEA design principles. Half of the activities in the 6th grade mathematics practices course book were below the general average in terms of compliance with the MEA design principles, while the other half scored above the general average. In the 7th grade mathematics practices course book,

the number of activities above the general average (58.5%) is higher than the number of activities below the general average (41.5%). Based on these results, it can be said that the current mathematics practices course books do not contain enough activities in terms of keeping the mathematical modeling process alive and developing mathematical modeling skills. Considering that the activities that adopt the mathematical modeling approach are not sufficient in the textbooks taught in Turkey (Çavuş-Erdem, Doğan, Gürbüz & Şahin, 2017), it is necessary to consider these principles in the design of the activities to be included in the textbooks to be written in the future, to develop mathematical modeling skills in students. is considered to be a guide.

According to another result obtained from the study, the general average of my activities in the 6th and 7th grade mathematics practice books in terms of self-evaluation principle was 0.44 and 0.33 points, respectively, and the MEA design principle with the lowest average score. In the 8th grade book, this principle was slightly above the intermediate level with a score of 0.51. The self-assessment principle states that students should self-assess the relevance and usefulness of their solutions, without teacher support or approval (Chamberlin & Moon 2005). The existence of this principle is important for students to go through the verification and interpretation steps and complete the mathematical modeling process in problem solving activities. For this reason, the activities to be designed should be prepared in a way that includes appropriate instructions in terms of comparing alternative ideas and eliminating the ones that do not work, evaluating the applications made, the model created and the solutions. The model eliciting principle, on the other hand, was below the general average (0.54) in terms of the activities in the 6th grade mathematics practices course book with an average of 0.46. Similarly, the average score (0.51) of the activities in the 8th grade mathematics practices course book for this principle is also below the general average score (0.59). Doruk (2019) also concluded that the level of providing the model eliciting principle of the activities included in the 5th grade mathematics applications teaching material is below the average. It was concluded that the average scores of the activities in the 7th grade mathematics practices course book for the principle of modeling were above the general average. The principle of model eliciting refers to the design of the problem situation in the activities in a way that requires modeling in the most general sense (Chamberlin & Moon 2005; Lesh et al. 2000). As Lesh et al. (2000) stated, the aim in model eliciting activities is not only to reach a decision, but to develop an appropriate tool that enables reaching decisions. In this respect, more emphasis should be placed on creating future activities in such a way that they realize the need for model development in order to interpret the given, desired and possible solution processes in a complex problem situation, rather than to make sense of the situations previously formulated by the authors. With the activities to be prepared in this way, it can be ensured that the students complete the model eliciting step, which is one of the most basic steps of the mathematical modeling process, in an appropriate way.

The result that the activities in the books examined in this study were more than moderately suitable for the model generalization principle differs from the result of Doruk (2019) that the activities in the 5th grade mathematics applications teaching material provided the model generalization principle below the medium level. As a result of the analysis conducted for the compliance of the activities in the 6th, 7th and 8th grade mathematics practice books with the model generalization principle, it was concluded that the general averages were 0.58, 0.56 and 0.56, respectively. In this respect, although the activities in the books are not completely, the model has been prepared by taking into account the generalization principle. However, it is still recommended to develop activities that provide the model generalization principle at a higher level. As a matter of fact, the structure of the activities is important in terms of observing and developing mathematical modeling competencies. The instructions included in the activities used in the learning environment designed by Aydın-Güç (2015) to develop mathematical modeling competencies affected the behavior of pre-service teachers towards generalization. In this context, if the activities contain instructions that lead to generalization, the pre-service teachers conducted studies on making generalizations, but they did not conduct a study on generalizing the solutions developed for a special situation in the activities that did not have a directive to generalize. In this context, more instructions should be given to enable the mathematical model expected to be created in the activities to be designed not only to be applicable to a special situation, but also to be used in other similar situations.

According to another conclusion reached in the research, most of the activities in all three books were prepared in accordance with the principles of effective prototype and reality. Similarly, Doruk (2019) concluded that the activities included in the 5th grade mathematics applications teaching material generally provide these two principals at a higher level than the others. The principle of effective prototype has been the most provided principle in the activities in all three books. In this respect, the activities in the books are designed without complexity in a way that allows students to produce a logical answer (develop a prototype) in general. In addition, the activities were generally prepared in terms of providing sample models that students can use to interpret the problem situations they will encounter in the future. When the activities in the books are examined in terms of compliance with the reality principle, it has been concluded that although the problem situation in some of the activities is not in a structure that can be encountered in real life, most of them are in a structure that can be perceived as realistic for students. This principle is also called the meaningfulness principle because students make sense of situations based on their own personal knowledge and experience (Chamberlin & Moon 2005; Lesh et al. 2000). Activities prepared in accordance with this principle will enable students to see the connections between mathematics and reality, as they require situations that can actually be encountered in their lives. In this way, the

activities to be designed with this principle in mind will help individuals, which is the main purpose of mathematics education, to produce solutions to the problems they encounter in daily life.

Finally, when the activities in the books were examined in terms of compliance with the model documentation principle, the activities in the 7th grade mathematics practices course book were below the medium level (0.46), while the activities in the 6th and 8th grade books were evaluated above the medium level with 0.55 and 0.56 points, respectively. Activities to be designed according to the model documentation principle require students to reveal their own way of thinking in their solutions while working on them (Chamberlin & Moon 2005). The activities prepared in accordance with this principle will enable students to interpret the mathematical models and solutions they have created, thus supporting their development of mathematical communication skills (Doerr & English 2006). In this context, it is suggested that the activities in the textbooks to be written in the future should be designed in a way that reveals what the students think in the modeling process. However, as Lesh et al. (2000) stated, considering that working together is another way of ensuring that students reflect their thoughts naturally, it can be suggested that the activities be designed in a way that requires collaborative work.

Based on the results of the research, the mathematics practices course books still used in secondary schools in Turkey should be updated by including activities based on the mathematical modeling approach and prepared in accordance with the MEA design principles in this context, as stated in the relevant curriculum. However, it is suggested that more activities should be included in the textbooks based on the mathematical modeling approach. In future studies, model eliciting activities in the textbooks of Turkey and other countries can be compared.

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Appendix A.

A.1. Criteria on Compliance with MEA (In the native language, Turkish)

1.Aşağıdaki maddeler model oluşturma prensibine uygunluk hakkındadır.	0	1	2
Görev öğrencileri karmaşık bir problem durumunda verilenler, istenenler ve muhtemel çözüm süreçlerini yorumlamak için bir model geliştirme gereksinimini fark ettirecek bir durum içine koyuyor.			
Görev öğrencileri bir soru için başkaları tarafından formüle edilmiş olan cevabı elde etmeye yönlendirmiyor.			
Görev üretilecek modeli, gözden geçirmeyi, düzeltmeyi, açıklamayı ve değiştirmeyi gerektiriyor.			
Görev, öğrencilerden problemin çözümü için bir model geliştirmeleri gerektiğini açıkça ifade ediyor.			
Görev, sembolik olarak ifade edilmiş durumları anlamlandırma yerine, o duruma uyan en uygun sembolik gösterimleri geliştirmeyi destekliyor.			
2. Aşağıdaki maddeler gerçeklik prensibine uygunluk hakkındadır.			
Görevin içerdiği problem durumu bire bir gerçek yaşamda karşılaşılabilecek yapıdadır.			
Görevin içerdiği problem durumu öğrenciler için gerçekçi algılanabilecek bir yapıdadır.			
Öğrenciler kendi deneyimleri ve bilgilerine dayanarak problem durumunu anlamlandırabilir.			
Çözüm sürecinde öğrencilerin fikirleri ciddiye alınıyor, yazarın problem için doğru yol olarak düşündüğü yola uymaya zorlanmıyor.			
3. Aşağıdaki maddeler model genelleştirme prensibine uygunluk hakkındadır.			
Görev oluşturulan modelin sadece onu geliştiren kişi için kullanışlı ve sadece özel bir duruma uygulanabilir olmasına değil, benzer başka durumlarda da kullanabilmesine olanak sağlıyor.			
Görev öğrencileri tekrar kullanılabilir, paylaşılabilir, üzerinde değişiklikler yapılabilir modeller üretmek için kafa yormaya yönlendiriyor.			
4. Aşağıdaki maddeler etkili ve basit prototip prensibine uygunluk hakkındadır.			
Görevin içerdiği problem durumu öğrencinin mantıklı bir cevap üretebilmesine (prototip geliştirmesine) olanak sağlayacak şekilde karmaşıklıktan uzak.			
Görevin içerdiği problemin çözümü yapısal olarak benzer problem durumlarını yorumlamak için kullanışlı bir prototip (örnek model) veya metafor (mecaz) sağlıyor.			
Görevin içerdiği problemin çözümü kavramsal ilişkileri fark etmeyi (prototip geliştirmeyi) engelleyecek düzeyde karmaşık hesaplama prosedürlerini içermiyor.			
5. Aşağıdaki maddeler model dışsallaştırma (düşüncelerini belgelendirme) prensibine uygunluk hakkındadır.			
Görevin içerdiği probleme verilen yanıt, öğrencilerin modelleme sürecinde neler			

düşündüklerini açığa çıkaracak şekilde.

Görevin içerdiği problem öğrencilerin çözüm süreci boyunca problem durumuyla ilgili kendi düşünceleri ve çözüm yollarını açıkça ortaya koyan bir belge oluşturmalarını gerektiriyor.

6. Aşağıdaki maddeler öz değerlendirme prensibine uygunluk hakkındadır.

Öğrenci, görevi yerine getirirken kendi yorumlarının ve ulaştığı sonuçların doğruluğunu kendi kontrol edebilir, geliştirme veya düzeltmeye gerek olup olmadığına karar verebilir.

Görevin içerdiği problem ifadesi güçlü bir şekilde alternatif çözümlerin kullanışlılığını değerlendirmek için uygunluk kriterleri öneriyor.

Görevin çerçevesi nettir.

A.2. The activities named "Sesame Street" with the highest level of compliance with MEA design principles and "Largest and Smallest Numbers" (MONE, 2017).

SESAME STREET

The Sesame Street Middle School Student Council, which has 350 students, is planning three separate events within the scope of the aid campaign organized for the needs of the school: a food market, a t-shirt-wristband sale with the school emblem printed, and a walking marathon.

The Student Council plans to generate a total income of 3000 TL. The cost of each of the t-shirts in the charity campaign is 4 TL and the transportation of all of them is 25 TL. The cost of the larger one is 5 TL, and the smaller one is 3 TL

Question 1: Find the total money required for the Student Council's "t" T-shirt order.

Question 2: If all students in the school want to buy one large bracelet and one small bracelet, write two equivalent algebraic expressions showing the amount the student council will pay for the order.

Question 3: How did you find out that the two expressions you wrote in question 2 are equivalent? Explain using mathematical concepts.

Three students from the student council are selling tickets for the school food market. Hakan sold 10 more tickets than Buğra and Buğra sold twice as many tickets as Mine sold.

Question 1: Write a statement showing the total number of tickets sold by three student council members.

Question 2: A total of 295 tickets were sold for the food market. Using the information above, find the number of tickets sold by Buğra, Hakan and Mine.

Question 3: Since everything in the food market is received as aid, all of the income from the tickets will be used for the

aid campaign. If all 295 students buy tickets for 6 TL each, how much money will the school council get from the food market? Show your transactions.

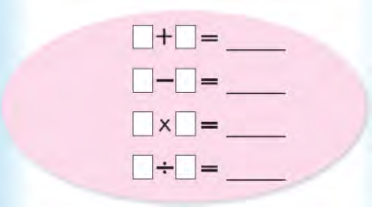
Question 4: The school council sold 63 T-shirts for 12 TL each, and 55 sets of bracelets, one of which is 5 TL and the smallest one is 3 TL. Write an equation that gives the amount of income from the fundraiser, including the money from the food market, and solve this equation.

Question 5: At the meeting held at the end of the aid campaign, Buğra said he was sorry because he thought they could not reach their goals. Is Bugra thinking right? Explain your answer with reasons.

THE BIGGEST AND THE SMALLEST NUMBERS

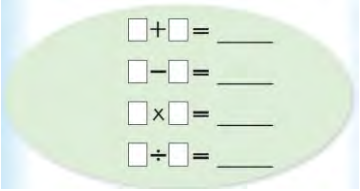
Question 1: For each operation, choose two different numbers from the numbers given below, and write the results of the operations below into the boxes as the largest number.

1, 2, 3, 10, 30, 50



Question 2: For each operation, choose two different numbers from among the numbers given below and write the results of the operations below into the boxes as the smallest number.

1, 2, 3, 10, 30, 50



Question 3: Explain how you chose the numbers so that the answer of a division is the smallest number/largest number.